Are electric vehicles masculinized? Gender, identity, and environmental values in Nordic transport practices and vehicle-to-grid (V2G) preferences

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1. Introduction

The gendering of mobility and even electric mobility has a long history, one that can be traced back to the 1880s, and it extends well beyond the "women" or "men like electric vehicles more" types of arguments. Some of the earliest discussions of automobility at this time, when electric vehicles (EVs) were more prominent (in terms of market share) than they are now, were gendered. Due to ease of operation and relative cleanliness, electric cars were known as "women's vehicles" in the 1900s (Scharff 2004). In the 1910s, the motoring literature was awash with descriptions of heroines, women who not only purchase cars, but were brave, independent, rationally skilled drivers and mechanics (Franz 2005). In the 1920s, it is women we have to thank for numerous improvements and innovations made through tinkering such as electric ignitions and starters, interior designs, safety harnesses, and larger trunks; women were also known as clever repairers, fixing carburetors with pebbles and hair pins. Women played an active role in the creation of user clubs, such as the Motor Girls Club in the United States. In discussions of safety, women were reputed as being more careful and less aggressive drivers, reporting fewer traffic accidents. The adoption of driving lastly enabled women to challenge dominant gender roles at the time, demonstrating their capability and autonomy in driving long distances—showing men (and society) that women could travel unescorted across a country. Manufacturers explicitly exploited similar gender norms when they tried to frame other types of cars as masculine at the dawn of the motoring age (Oldenziel 1997).

Some of these gendered aspects of mobility extend into today, especially when one examines the preferences held for different modes of transport. As Sola (p. 34) writes, "differences between women and men are found in several dimensions of mobility, and … the

magnitude of gender differences can shift between dimensions." Friis et al. (2016) also write that focusing on demographic dimensions such as gender can offer a more comprehensive understanding of how households and adopters interact with EV technology[1]. But how exactly?

In this paper, we conduct a mixed methods and comparative investigation of gender, electric mobility, and vehicle-to-grid (V2G), where EVs can store energy and offer services to the grid (Kempton and Letendre 1997; Kempton and Tomic 2005a, 2005b; Letendre and Kempton 2002; Tomic and Kempton 2007; Sovacool et al. 2017). A V2G transition has the potential to enable countries around the world to start the process of decarbonizing their transport sectors, better balance and integrate renewable sources of energy into the grid, and to maximize revenues for electricity companies and create new revenue streams for automobile owners (Noel et al. 2019a). We explore and analyze how the stated preferences for electric vehicles and V2G systems differ by gender (or not), based on three mixed methods (a survey, expert interviews, and focus groups) across all five countries in the Nordic region (Denmark, Finland, Iceland, Norway and Sweden). Our aim is to uncover the more subtle and complex, but also meaningful, ways that gender may influence people's perceptions and preferences for electric mobility, V2G, and even conventional forms of mobility. Although one must take care about promoting gender essentialism or determinism—reducing everything to biology or gender—our data does show. in statistically significant ways, how men and women self-reportedly differ in how they use transport (or "consume" mobility services), express preferences for transport modes, and prioritize the particular attributes of vehicles.

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[1] We use the term "EV technology" as a blanket phrase that includes hybrid electric vehicles, plug-in hybrid electric vehicles, battery electric vehicles, and range-extended electric vehicles.

2. Research Design: Surveys, interviews and focus groups

To collect original data on gender, electric mobility, and V2G, we relied on three mixed methods: a survey, interviews, and focus groups. Data collection for all three methods was in English, and it took place from September 2016 to October 2017 and centered on the sociotechnical benefits and barriers of both electric vehicles and V2G technology.

2.1 A mixed-sample survey

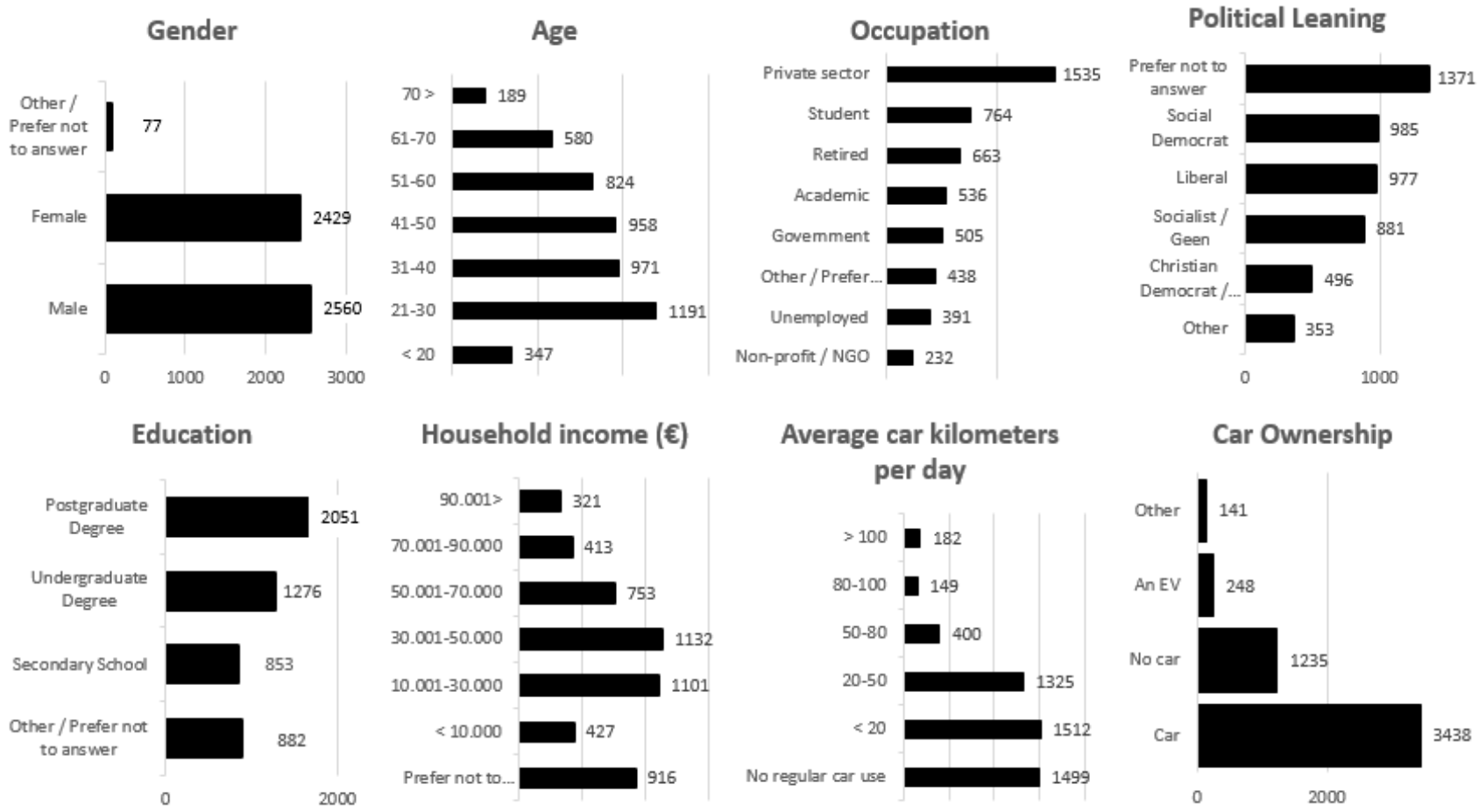
We first relied on a structured questionnaire (a "survey"), distributed as an online panel via the survey consulting firm Qualtrics. The survey consisted of three parts, including a choice experiment, which we do not report here (as it is covered in Noel et al. 2018), and 44 questions about mobility and EVs. The first part asked about the vehicle background and the existing mobility patterns of respondents, namely how often and how far they drive, a ranking of most used transport mode per month, how much they were willing to pay for their next car. The second part explored what respondents valued most (or least) when they considered future purchases and forms of mobility, such as acceleration, size, safety, etc. as well as some questions specifically about EVs (such as charging availability, range, battery life, and so on), asking them to rate these features according to a five point Likert (1932) type scale ranging from very unimportant to very important. The final part of the survey contained questions about basic demographic information such as age, gender, education, and occupation as well as more sensitive questions about income, political affiliation, and environmental values (among others). A copy of our structured questionnaire is offered in Appendix I.

Distribution of the survey was online, anonymous, and intended to have a mix of randomized respondents, as well as more targeted or in-depth respondents from underrepresented classes, e.g. early EV adopters or residents in remote areas. Our survey was therefore completed

by a mix of 4,322 random respondents (distributed via Qualtrics) and 745 non-random respondents (distributed via the research team) shown in Table 1. This puts the total respondent number at 5,067, and this already excludes surveys that were incomplete or obviously answered falsely.

Figure 1 offers some basic demographic details about our combined survey sample. As it indicates, there was an almost even split among gender (50.5% men, 47.9% women) and a fair distribution across age, political orientation, and education. The sample of respondents shows more variance for occupation (more private sector participants than others), income (most respondents in the so-called "middle class"), kilometers travelled (most fewer than 50 km a day), and car ownership (most own at least one car). Although demographic data at the regional scale of the Nordic countries was limited—most data is published only at the country scale, and even then it did not involve all of our categories, such as political leaning or kilometers travelled—the Nordic Council of Ministers (2017) suggests that our sample is nearly representative of the general population (within a few percentage points) for patterns in gender and age.

Figure 1: Demographic characteristics of Nordic transport survey sample (n=5067)



Source: Authors

2.2 Qualitative expert research interviews

Secondly, the authors conducted 227 semi-structured expert interviews with 257 participants (some interviews had multiple participants) from over 200 institutions in the five Nordic countries. The reasoning for such a large number of interviews was simple: to collect as much data as possible so that our findings are more robust, and have a greater degree of internal triangulation across the countries, focus areas and sectors that we interviewed. As shown in Table 1, the experts represent a diverse—but by no means fully representative—array of stakeholders involved in transportation, energy and the environment. Interestingly, unlike the sample of survey respondents, our expert interviews were much more skewed towards men, perhaps reflecting gender biases within the commercial, consulting, and research communities. For instance, more men tend to have PhDs than women (National Academies of Science 2007; Husu 2000), more men tend to occupy senior positions in companies (Terjesen and Singh 2008), and gender pay gaps have been shown to exist in the Nordic corporate sector (Smith et al. 2011).

Table 1: Characteristics of Nordic research interview sample

Classifications	**Interviews (n=227)**	**Respondents (n=257)**	**% of Respondents**
Country = Iceland (Sept-Oct 2016)	29	36	14.0%
Country = Sweden (Nov-Dec 2016)	42	44	17.1%
Country = Denmark (Jan-Mar 2017)	45	53	20.6%
Country = Finland (Mar 2017)	50	57	22.2%
Country = Norway (Apr-May 2017)	61	67	26.1%
Gender = Male	160	207	80,5%
Gender = Female	40	50	19.5%
Gender = Group	27		
Focus = Transport or Logistics	73	81	31.5%
Focus = Energy or Electricity System	63	75	29.2%
Focus = Funding or Investment	10	12	4.7%
Focus = Environment or Climate Change	12	16	6.2%
Focus = Fuel Consumption and Technology	22	23	8.9%
Focus = Other	13	14	5.4%
Focus = EVs and Charging Technology	34	36	14.0%
Sector = Commercial	68	70	27.2%
Sector = Public	37	46	17.9%
Sector = Semi-Public	40	51	19.8%
Sector = Research	37	39	15.2%
Sector = Non-Profit and Media	12	13	5.1%

Sector = Lobby	23	25	9.7%
Sector = Consultancy	10	10	3.9%

Source: Authors. Focus represents the primary focus area of the organization or person in question, sector represents the sector the company was working in (semi-public referring to commercial companies owned by public authorities, like DSOs).

The research interviews generally lasted between thirty and ninety minutes, and participants were asked several questions as part of a larger research project about the benefits and barriers of both EVs and V2G (Kester et al. 2018a; Kester et al. 2018b; Noel et al. 2018; Sovacool et al. 2018b; Sovacool et al. 2018c). The research interviews were done by a team of four, and the first 100 or so interviews were conducted by at least two team members in revolving compositions. After that three team members went on individually or together depending on the scheduling of interviews. Besides a strategy session and reflection at the end of the day, the research team did not check for inter-interviewer reliability and readily admit that there is some level of variance that bleeds through the follow up questions. Still, we made sure that each of the leading questions were asked and answered, and most of the follow up questions derived from answers provided to us. Furthermore, all interviews were recorded so that transcriptions and statements could be checked for accuracy. After collection of the interview data, each interview was subsequently fully transcribed, and then coded. Our coding scheme was exhaustive and inductive, meaning we coded every response and then analyzed the full sample using NVIVO.

We have presented data from the interviews in pure form, even statements which may be considered racist, sexist, and offensive, to present a fuller picture of our evidence and to avoid any form of censorship or sanitization of results. While this may appear unusual, the use of profane statements or swearing is seen in the research methodology literature as an appropriate means of expressing emotions, especially anger and frustration, or conveying context (Jay and Janschewitz 2008). Attempts to restrict speech also ignore situations where the use of profanity or offensive language can be advantageous, cathartic, or an acceptable

substitute for physical aggression (Jay 2000). Lastly, we concur with Reisigl and Wodak (2000) who suggest that it is a social imperative that critical research (such as ours) take into account and therefore document racist (or otherwise sexist or offensive statements) when they do occur so that they can be exposed, discussed and assessed. Thus, this article does contain potentially offensive and profane statements as a matter of both academic integrity and research ethics (not removing data) as well as a normative commitment (identifying and critically reflecting) to challenging racism, sexism, and discrimination.

2.3 Public focus groups

Lastly, while expert interviews provided in-depth discussion of EVs, focus groups were concomitantly organized in order to complement expert perspectives with those from the general public. In total, eight focus groups were conducted, with 61 combined participants across six Nordic cities, as shown in Table 2. We attempted to organize focus groups in every city we visited based on two requirements: participants had to be over 18 so they *could* have a driver's license – we were equally interested in the contextualization of EVs in relation to public transport and car ownership more generally so we didn't want to make it a hard requirement to have a driving license; and they had to live in the region for more than two years (to focus on local inhabitants). Admittedly, as we recruited our focus groups through local university connections and university wide emails (Iceland, Sweden, and Finland) as well as though psychology labs and their email lists (Denmark, Norway), they may not reflect a "pure" or representative public sample. In addition, two of these focus groups were exclusively a single gender (one all-male, one all-female) and asked additional questions about how gender affects EVs. The reason for the one all-female and one all-male group was that we observed some gender reflections in the other countries and we wanted to collect data from single sex groups to see if it facilitated more detailed discussions about gender—which it did. Each focus group was asked similar questions to the interviews,

namely about perceptions of EVs and V2G benefits and barriers to adoption. However, the free-flowing nature of focus groups also allowed the discussion to cover various other relevant topics. Similarly, after data collection was complete, each focus group was fully transcribed and coded. And, similar to the interviews, our coding scheme was exhaustive, recording every statement.

Table 2: Characteristics of Nordic focus group sample

Classifications	Participants (n=61)	% of Participants
F1: Iceland (Oct 2016)	5	8.2%
F2: Sweden (Nov 2016)	6	9.8%
F3: Denmark [Mixed Gender] (Feb 2017)	10	16.4%
F4: Finland 1 (Mar 2017)	9	14.8%
F5: Finland 2 (Mar 2017)	7	11.5%
F6: Denmark [Male] (Jun 2017)	7	11.5%
F7: Denmark [Female] (Jun 2017)	8	13.1%
F8: Norway (Sept 2017)	9	14.8%
Gender = Male	29	47.5%
Gender = Female	32	52.5%
Have Driver's License	50	81.9%
Currently own a car	29	47.5%
Experienced an EV (as driver or passenger)	8	13.1%
Own an EV	0	0.0%

Source: Authors

2.4 Data analysis

The data across all three mixed methods was analyzed statistically through frequency analyses and single level data analyses to find clear associations and variances (when they existed) between the self-reported gender of respondents, and other variables related to travel patterns, car use, EV background and vehicle preferences. Here, we relied primarily on the techniques summarized by Kirkpatrick (2013) and utilized SPSS Statistics Software version 25.

In addition, Spearman's Correlation or Spearman's Rho was chosen for the fact that all variables are either ordinalized nominals (like car ownership and the gender variables) or ordinal themselves (like the stated preference for specific car characteristics). In simpler

terms: more important for us is the repetitive difference between mean scores for men and women – the gender difference! – and how that difference might change for subclasses, rather than a true multivariate regression analysis of all of our data. The standard approach we used to calculate Spearman's Rho is based on Kendall (1955) and Siegel (1956) and presented in IBM (2017: 208 and 720). When discussing Spearman's Rho, we focus mainly on the significance level ($p<.001$) because then the monotonic relationship – low as it is – is most likely present in real life as well. Here, (p) measures the coincidence that these rankings are correlated, not the actual variables.

2.5 Literature review

To situate and ground our hypotheses within the academic literature, we searched for studies published with the words "electric mobility," "mobility," "electric vehicle," "carbon," "travel" and "transport" in the titles, abstract, and keywords of full length articles alongside the words "gender," "women," "men," "identity," "feminine," "femininity," and "masculinity." This resulted in a corpus of work consisting of roughly 50 studies, many of which we cite below.

2.6 Limitations

Admittedly, despite mixing methods and having a strong degree of triangulation between those methods, our research design has a number of limitations. First, as mentioned, for the survey we combined a sample of randomized respondents with a purposive sample to increase response rates from Iceland and to include the views from early adopters or previous owners of EVs, which are hard to reach groups (Rezvani et al. 2015; Sovacool et al. 2018a). Second, we treat all of the stated preferences from respondents as uncorrected and true, even though some may have answered questions incorrectly or inaccurately. Third, while we examined gender though the lens of sex, we did so within a binary approach (male and female demographic criteria, feminine and masculine traits) that excluded by definition other

genders such as transsexual or intersex identities. In this sense, we look at gender, but not gendering—and largely due to the fact that a strong majority of respondents identified themselves as (more conventionally) only male or female. In the survey, for instance, only 77 respondents (or 1.5% of the total sample) chose "other" or "prefer not to answer" when disclosing gender, and did not further distinguish any information about their gender identity. This subsample size was too small to lend itself to rigorous analysis.

3. Gender and Mobility: Four research themes

Our literature review suggests that academic analysis, spanning a period of at least 40 years, can fall into promoting one of four different themes concerning gender, mobility, and electric mobility.

3.1 A gender travel gap

The first research theme emphasizes gendered travel patterns or a gender gap in travel. Earlier work in the 1970s focused on constraints on women's mobility related to fear of violence, and shorter commuting distances or durations (Scheiner and Holz-Rau 2012a). Work that is more recent has reiterated a "traffic gap" between men and women, with women less likely to travel further, with fewer destinations to travel, and also with women traveling more frequently with children or when shopping (Kawgan-Kagan 2015).

In Colombia, for instance, women generally have less mobility per capita due to higher average travel times and higher percentage of income spent in transport (Lecompte and Bocarejo 2017). In India, women walk more than men (Mahadevia and Advani 2016). In Australia, women are more sensitive to lost time waiting for a bus or crowdedness, whereas men are more sensitive to the walking times to stations and fuel costs (Zheng et al. 2016). In Serbia, women make almost twice as many shopping trips relative to men; travel more in the afternoon; are more frequently passengers rather than drivers; and are more likely

to use taxis (Basaric et al. 2016). In Spain, women are more likely to cycle or walk compared to men; less likely to rely on private transport; and far more likely to utilize public transport (Sanchez and Gonzalez 2016). In Sweden, women use a private car less than men, and their "intention to reduce car use is significantly stronger, even when controlling for socio-demographics and attitudes" (Polk 2004: 186). In Denmark, 9% of women reported not driving compared to 3% of men; men reported far higher annual mileage as well, 22,500 km compared to 14,500 km per year (Siren and Haustein 2013). A higher proportion of women in the United Kingdom were found to use park and ride facilities compared to men, mirroring a national gender difference in local bus service (Clayton et al. 2014). In Germany, gender differences can become stark in car-deficient households (where men and women must share a single car): there, women drive a car an average of 812 minutes per week less than men do (Scheiner and Holz-Rau 2012b). Similarly, in Germany, there are "gender based hurdles" in ridesharing services with women generally excluded (Kawgan-Kagan and Popp 2018).

Moving beyond individual country studies, across all of Europe, the Eurobarometer survey reports that a higher proportion of men travel by car and motorcycle relative to women, who in turn walk and use public transport and bicycles more than men do (European Commission 2007). Consequently, we hypothesize that men are more mobile than women, and express this preference for mobility in higher rates of car ownership, car use, and the avoidance of public transport. Extending this logic, we hypothesize that men will use EVs more than women.

3.2 Feminine values

A second research theme focuses on values, often inferred from stated preferences and surveys. The implication from this theme is that women possess values that are more pro-environmental or pro-sustainability, values that they can pass on to others, such as their family.

Women are reported to be slightly more aware of environmental concerns then men, with women in particular expressing greater concern about household related aspects such as waste separation and healthy food (Kawgan-Kagan 2015). In Finland for instance, men are more skeptical about the seriousness of climate change (Upham et al. 2015). Kellstedt et al. (2008) write that studies "consistently show that women and racial minorities are more fearful of the risks of climate change" and that "traditional divisions of labor account for higher levels of environmental concern among women." O'Connor et al. (1999) and Viscusi and Zeckhauser (2006) have also identified a "gender-based" disparity regarding climate change attitudes and perceptions, while Denton (2002) argued that women would be disproportionately affected by climate change vulnerabilities, and therefore, place greater importance on mitigating such damage.

More abstractly, Lutzenhiser (1993: 270) has argued "mothers may have the greater role in transmitting environmental values." We thus hypothesize that women have stronger preferences for the environmentally friendly attributes of vehicles (including EVs) in our survey.

3.3 Gendered preferences

A third stream suggests that general environmental values can spillover into transport preferences, with Fan (2017: 280) writing, "women also report greater concerns towards environmental issues and more willingness to reduce their auto use than men do for sustainability reasons." Similarly, Kronsell et al. (2016) state that in Sweden "women still on average have transportation behavior with lower environmental impact than men have; women also tend to have stronger preferences for improving sustainability in the sector."

Other research suggests that women tend to have "travel-minimizing attitudes and lower preferences towards power and performance in their vehicles than men" (Fan 2017:

288). Women generally hold stronger preferences for dedicated spaces for cycling compared to men, whereas men are more willing to cycle in "unsafe" places to signify confidence or bravery (Aldred et al. 2017). When considering different smart phone apps, women emphasize safety aspects more than men do (McCarthy et al. 2016).

Some research even supports the stereotype about men never asking for directions, with women more willing to discuss navigational difficulties than men do, and women more receptive to the use of navigational tools (Edwards et al. 2016). A survey of students in the United States indicated that more men valued the fastness of a given route, while more women valued safety concerns (Nasar et al. 1993).

Yet another strand of this literature emphasizes different gendered conceptions of how men versus women express their preferences. In their systematic review, Daramy-Williams et al. (2019) report that women are more likely to discuss EVs in "practical, present-oriented terms," whereas men express EVs "in more future-oriented ways, discussing topics such as research and development."

Another survey even implied that greener forms of transport such as EVs make adopters more appealing, with 88 percent of women indicating they would rather talk to the owner of a fuel-efficient car than a driver of a conventional sports car (Croeni 2010). In Sweden, similarly, women tend to place a greater value on the environmental and climate benefits of EVs compared to the values that men prioritize (Vassileva and Campillo 2017). We thus hypothesize (again) that women are more environmentally aware and will express this in their mobility preferences.

3.4 Gender norms and roles

A fourth research theme is perhaps the most complex, and thus the most prosaic and abstract. Instead of emphasizing patterns, values, or preferences, it discusses hierarchical

gender norms and roles. Research in this theme supposes that society as a whole still operates according to patriarchal gender roles that undervalue domestic or feminine tasks that women perform, and overvalue the more masculine tasks that men perform. These gender roles require or demand that women manage the house and take care of children, in essence limiting their access to key resources such as a car, mobility, or free time (Fan 2017). Urban form can be gendered as well, and gendering can impact transport infrastructure and mobility patterns (Miranne and Young 2000; Tonkiss 2005). For instance, there are gendered aspects of mobility in regards to parenting, that is, that women have more mobility demand related to gender roles of taking care of children. According to this view, gendered differences in travel arise because of spouse/partner presence, parenthood, and who occupies the "breadwinner status" for a household (Fan 2017). Thus, travel preferences become shaped by unequal participation in the labor market (fewer women than men) resulting in different household responsibilities, that is "women's dual roles as mothers and wage earners heavily constrain their time use and activity space" (Sola 2016: 33).

Structural gendered contexts such as differences in job tenure, work hours, and wages can explain differences in work commute distance and time (Fan 2017). These structural factors make gender gaps entrenched and resistant to change – one survey in Germany found that between 1994 and 2008, the year of observation had "no notable effect" on the gendered aspects of travel, suggesting little change over that period (Scheiner and Holz-Rao 2012a). Some even conceptualize a "Gender Socialization Theory" noting that "females tend to be socialized toward a feminine identity stressing attachment, empathy, and care, and males tend to be socialized toward a masculine identity stressing detachment, control, and mastery in many countries around the world" (McCright et al. 2016). Based on this research, we loosely hypothesize that women attach less importance to speed, power, or sound when they consider vehicle attributes, and would emphasize safety and sustainability more than men.

4. Results and Discussion: Examining three hypotheses about gender

In sum, our four strands of literature lead us generally to three testable consolidated hypotheses. Because of our focus on gender, we are less interested in hypotheses on other demographic or spatial categories including household size, geographic location (urban, rural), or education, although these should certainly be explored in other research.

The research on a gender travel gap suggests that men will use cars more than women, more often own a car, drive further than women, and use less public transport. It also suggests that men will use EVs more and have more experience with EVs than women. These can be combined into:

> *H1: Men use cars (conventional and electric) more than women, more often own a car or EV, drive further than women, and use less public transport.*

The two research streams on values and stated preferences suggests that:

> *H2: Women have stronger preferences for the environmentally friendly or safety attributes of vehicles and have higher levels of general environmental awareness.*

Lastly, while more difficult to concretize into a hypothesis, the research stream on gender norms suggests that:

> *H3: Women attach less importance to acceleration, power, or sound, whereas men will emphasize range, sex appeal, and acceleration.*

In the remainder of this section, we proceed to test each hypothesis in turn with our mixed methods data.

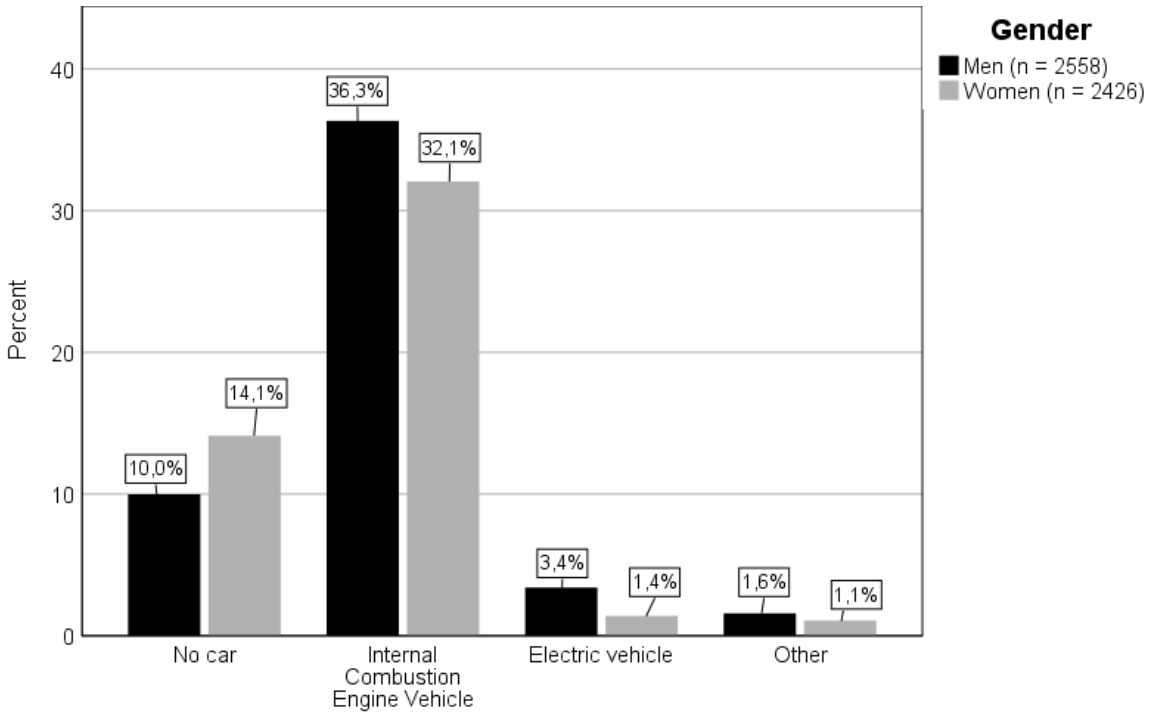
4.1 H1: Men use cars (conventional and electric) more than women, more often own a car or EV, drive further than women, and use less public transport.

Our data supports this hypothesis, in all of its variants. EV interest, EV ownership, kilometers driven per day, EV range and gender are negatively correlated, indicating more men stating that they own an EV, more men interested in EVs, and men driving more per day. Adding a bit of nuance, self-reported travel distances (more kilometers a day) is positively correlated to EV ownership, but this is not the case for EV interest. E.g., it doesn't matter how much you drive to be interested in EVs, but those currently owning an EV drive on average a bit more. This perhaps indicates that EVs are becoming more mainstream and are appealing more to certain types of mobility users (those who drive enough to capture operational savings of an EV).

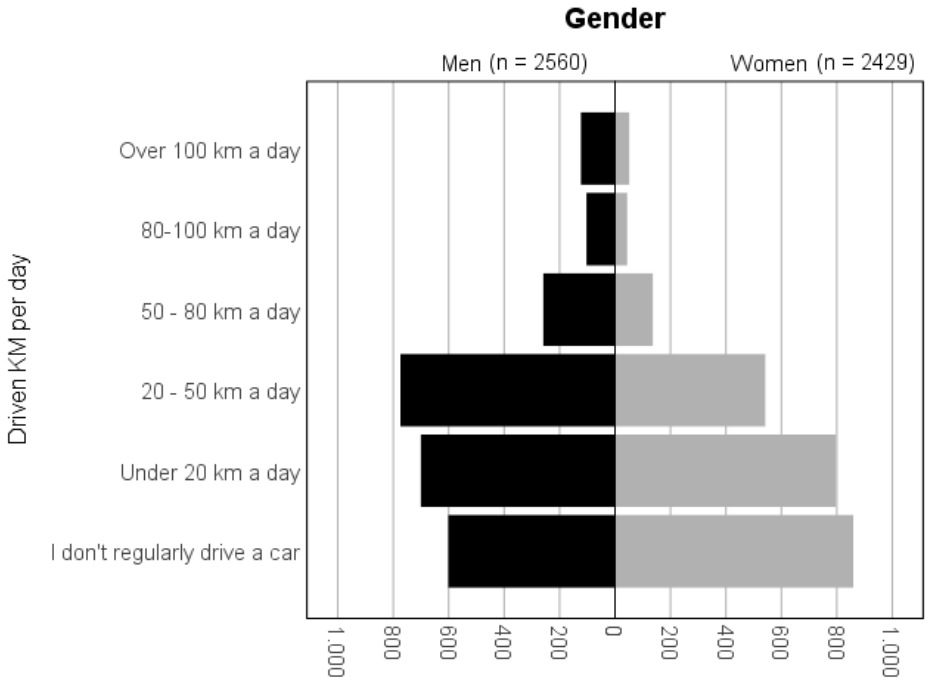
For instance, our survey data shown in Figure 2 suggests that more than 36% of male respondents (n=2558) stated they owned a car compared to 32% of women (n=2426), and more than two times as many men stated they own an EV. The self-reported data suggest that men travel more than women as well in terms of total kilometers per day, especially in the 20 to 50 km/day category and the over 50 km/day categories. Men rank their average monthly public transport use clearly lower than private transport and, importantly, also rank public transport use lower than women do. In turn, women rank private transport lower than men. Yet, both rank their monthly use of active modes of transport above private modes of transport. However the differences are modest for gender (except in EV ownership). Although gender has an effect, it appears to be less important than other determinants of ownership, like travel distance and public transit. Stated ownership of EVs stands out as the most heavily influenced by gender—and approximately twice as many men own EVs compared to women—a reversal of the early 19th century gender association.

Figure 2: Car ownership, travel patterns, and public transport preferences by gender

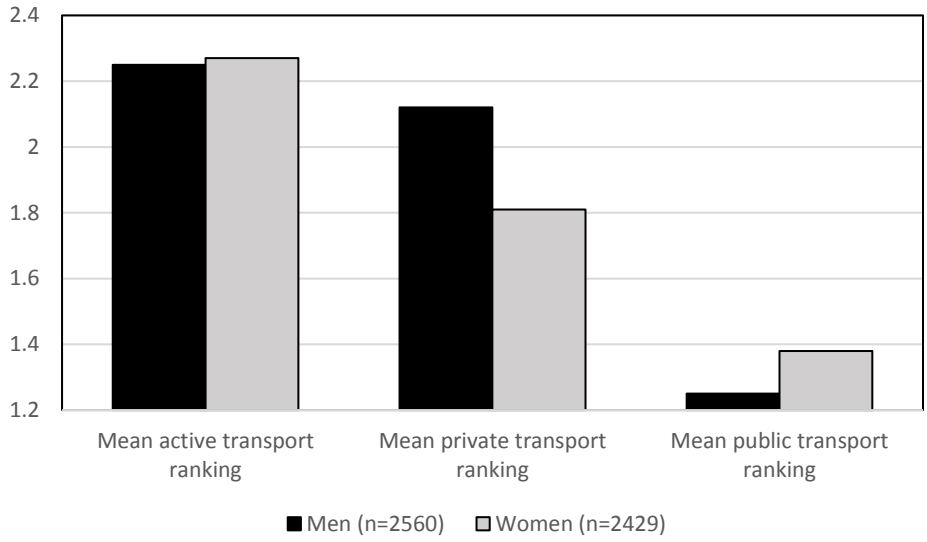
a. *Top panel: Car and EV ownership*



b. *Middle panel: Daily kilometers travelled*



c. *Bottom panel: Mean ranking score of active, private and public transport modes*



Source: Authors.

Our interview and focus group data offer insights and explanations behind these numbers, especially a preference for automobility, across both genders. As R9, a female energy expert in Iceland, reflected:

> *People here really like their big Jeeps and the idea of freedom that they represent, that you can go up to the glacier whenever you want to, even though what you end up doing is going to the bakery.*

R51, a male energy expert, noted:

> *People want a normal car with a towing hitch or a big truck.*

R140, a transport and logistics planner in Finland, remarked that:

> *The most common EV in the Nordic Region is a Tesla … It is a beautiful car, cool to have.*

These statements all support the desirability of private cars that conceivably most of our respondents can drive.

However, the focus groups especially revealed compelling reasons as to how such preferences for mobility are influenced by gender. A female participant in FG1 positioned having a car, especially in the Nordic region, as a satisfaction of "Viking" identity:

> *Most boys I know … want to drive big, fancy cars, or trucks, for going into the country, or they buy a car just for the looks. There are all these small cars but nobody buys them, especially those seeking to be macho "Viking men."*

A male participant in FG3 mentioned that having a car fits in with advertised "male needs":

> *Well if you have a car, you get the girl, if you get the girl you have like a family, you have like success. If you don't have a car you can't really get out and expect to get anything.*

In FG7, one of the female participants similarly commented how the automobility system is mostly populated with men:

> *More mechanics are men, that's a very male-dominated branch, men are the decision-makers around the house, and most car salespersons are men. Men always seem to go on and kick the tires [laughter]. And when I think about my parents, it was always my dad who wanted a huge-ass station-wagon and it was my mom who got a little car because she also needed to go to work and stuff. But I always thought: why on earth would my dad buy a car with five seats when he's not traveling to Croatia with the family and a pack of dogs, he doesn't have a farm, he doesn't need to transport anything? "Well I needed a proper car" is what he would say. Somehow, it has stereotypically been decided in a man's brain that he must have a big car.*

In this way Nordic automobility practices and patterns seem to be significantly influenced by gender.

4.2 H2: Women have stronger preferences for the environmentally friendly or safety attributes of vehicles and have higher levels of general environmental awareness.

Our data also mostly supports this hypothesis, although with more variation and nuance. As Table 3 presents, our survey results suggest that gender (F = 1) was positively correlated to safety, ease of operation, operational costs, purchase price, and environmental impact, indicating that women do seem to find these aspects more salient. A similar trend occurs between gender (F=1) for general environmental importance. Stated preferences for speed and acceleration, an EV characteristic of most mid-sized EVs, is of greater importance to men. Looking more closely at the different levels of EV interest among men and women and how that correlates to car characteristics and environmental concern, the sample shows stated EV interest (M = 1 and F =1) to be strongly correlated to general environmental importance and the number of environmental actions taken, but this is more or less equally distributed across gender. Surprisingly, this does not extend to stated EV owners, as male EV owners have a higher correlation than female EV owners to both general environmental concern and environmental actions taken. The V2G element of electric mobility had a minor but significant correlation to gender and stated EV interest; in fact, women seem to favor it a slightly more than men. That said, there is no significant correlation with existing male or female EV owners, which is not surprising given that V2G technology is not widely available or commercialized yet.

Table 3: Survey results examining correlations between gender and transport background, car characteristics, and environmental awareness by gender

	Gender M=1, (n=5067)	**Gender F=1, (n=5067)**	**EV interest M (n=2311)**	**EV Interest F (n=2305)**	**EV ownership M (n=2560)**	**EV ownership F (n=2429)**
EV interest	.049**	-.040**				

EV ownership	.079**	-.094**				
Transport background						
Car ownership	.113**	-.099**	.001	.093**	.105**	.098**
Driver license time	.159**	-.139**	-.022	.051*	-.093**	-.002
KM per day	.188**	-.179**	-.018	.049*	.172**	.150**
Longest car trip	.169**	-.162**	.030	.091**	.051*	.036
EV Experience	.158**	-.155**	.176**	.181**	.357**	.352**
Public transport rank	-.047**	.044**	.071**	.033	.018	-.016
Private transport rank	.093**	-.081**	-.067**	.025	.061**	.069**
Active transport rank	.000	-.003	.060**	-.004	-.078**	-.067**
Car characteristics						
Imp. of speed & acceleration	.055**	-.050**	.064**	.079**	.162**	.084**
Imp. of size & comfort	-.010	.029*	.050*	.136**	0.027	-0.031
Imp. of design & style	.048**	-.034*	.082**	.083**	.071**	0.039
Imp. of ease of operation	-.082**	.096**	.185**	.200**	0.021	-0.015
Imp. of technical reliability	.082**	-.068**	.182**	.262**	-0.024	-0.020
Imp. of safety	-.143**	.159**	.185**	.191**	-0.020	-.065**
Imp. of fuel economy & financial savings	-.093**	.105**	.247**	.275**	-0.035	-0.037
Imp. of purchase price	-.101**	.107**	.039	.015	-.146**	-.084**
Imp. of environmental impact	-.110**	.112**	.391**	.457**	.135**	.040*
Imp. of EV range	.132**	-.120**	.000	.150**	-.042*	-0.010
Imp. of EV battery life	.008	.010	.039	.137**	-.138**	-.072**
Imp. of public charging	-.049**	.063**	.051*	.169**	-.123**	-.133**
Imp. of charging time	-.008	.022	.011	.100**	-.070**	-.079**
Imp. of V2G capacity	-.067**	.074**	.097**	.129**	.012	-.008
Environmental awareness						
Importance of environment in general	-.099**	.097**	.312**	.347**	.162**	.050*
Environmental action score	-.028*	.023	.255**	.260**	.146**	.096**
Demographics						
Age	.185**	-.171**	-.157**	-.099**	-.133**	-.018
Household size	-.027	.029*	.114**	.135**	.167**	.113**
Nr. of adults	-.033*	.035*	.046*	.092**	.093**	.036
Nr. of children	-.004	.006	.138**	.146**	.165**	.124**
Nr. of cars	.057**	-.054**	-.037	.032	.188**	.109**
Urbanization	.08	-.002	.064**	.067**	-.072**	-.041*
Household Income	.191**	-.171**	.104**	.153**	.148**	.088**

Source: Authors. Note: Spearman's Rho correlated at *0.05** or *0.01*** level.

Why weren't stated preferences for V2G more prominent? Even within our expert interview sample, which was more highly educated, there remained an admission that V2G remains a confusing topic, not only to technical experts but especially to ordinary members of the public. R86, a male expert in electric mobility, reflected on some of the questions they received in their own V2G project:

> *People asked us: What the hell is V2G? That doesn't suck my vehicles dry so I can't drive? Or what is going on? Why is my neighbour getting my power? How do you explain why the electric power should be able to leave your vehicles and assure people that it's under control and won't leave you with an empty vehicle every morning?*

R246, a female expert in electric vehicle adoption, added that when trying to clarify what V2G was with consumers, *"the whole concept was so weird to them."*

This lack of knowledge about V2G extended well into the focus groups. In FG5, we had the following exchange:

> *Researcher: Ok, so a part of our grant is about batteries, we call it "vehicle-to-grid." Who here has heard of that term?*
>
> *Respondents: Can you say that again?*
>
> *Researcher: Who has heard of vehicle-to-grid, V2G. [Looks around]. Ok. None of you have.*

And, when asked the same question in FG7, respondents clarified:

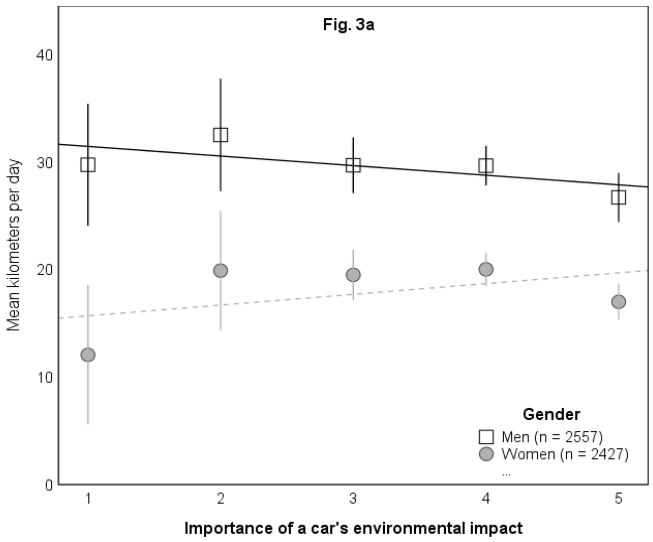
> *I feel like I know about [V2G], and should do it [laughter], I feel like it's a nice deal, but yeah I guess I need a little more information about it. What are the consequences for my car? If you get the money returned each month, then it would probably be the same cost anyway. And what about charging? And damage to my car?*

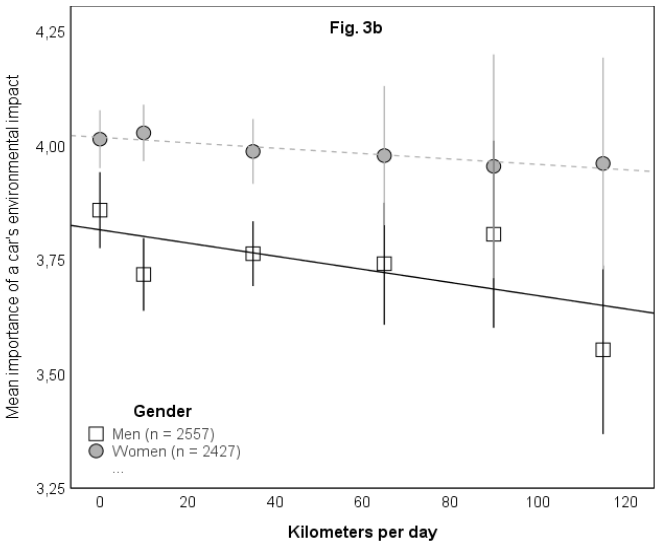
This ignorance or ambivalence about V2G—people do not know enough—likely explains its limited import across our sample of participants.

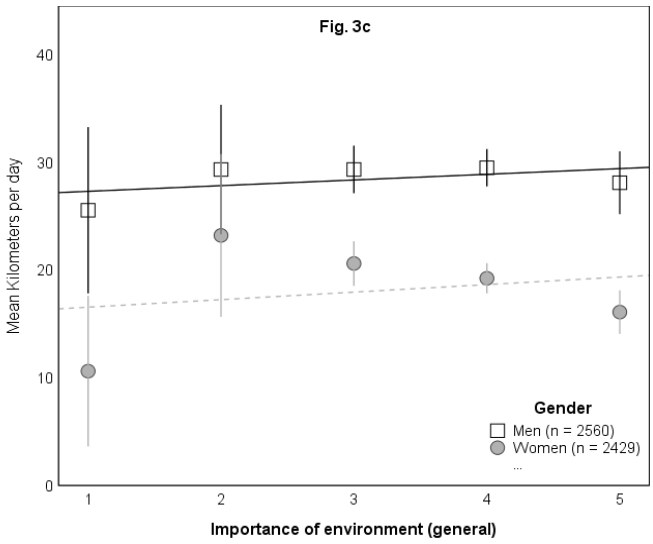
When looking at the importance of the environmental impact of cars (see Figure 3a), it is clear that the self-reported data for mean km a day is lower for women compared to men,

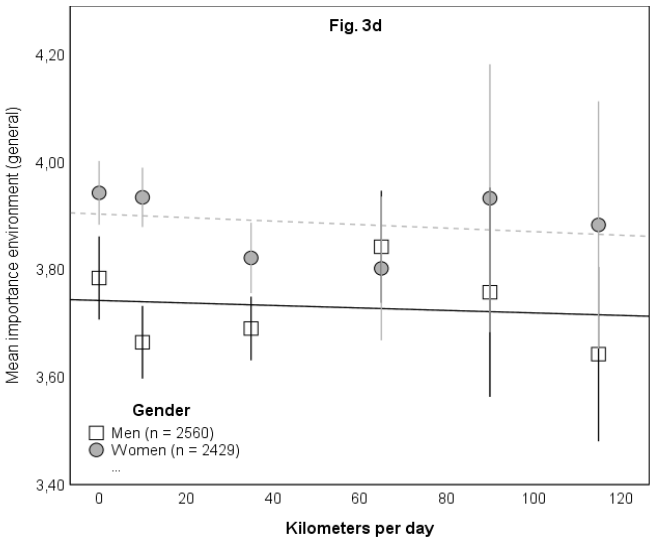
in line with the negative correlation of Table 3 between gender (F=1) and car ownership as well as daily kilometers. Importantly, Figure 3a indicates that this lower mean continues irrespective to the attached importance to the environmental impact of cars. Reversing the relationship (Figure 3b) shows a very slight negative correlation between the stated importance of a car's environmental impact and daily kilometers for both men and women. Men who travel frequently especially rank the environmental impact of a car lowest of all (although the spread shows that these mean scores are dispersed widely).

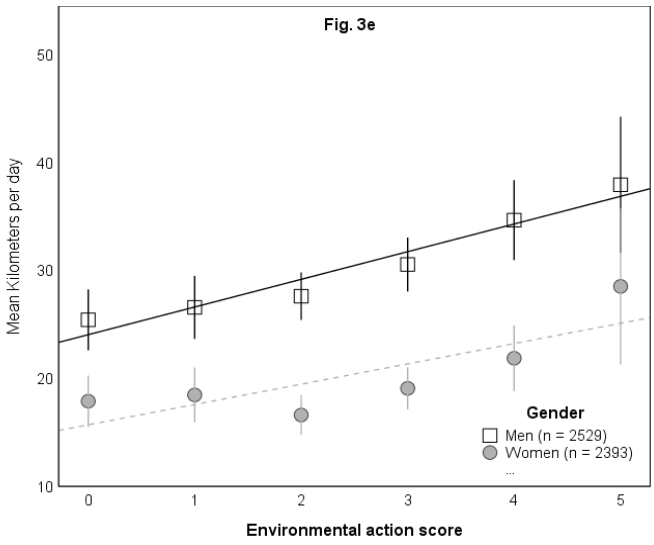
Figure 3: Survey results reporting daily kilometers travelled and environmental awareness by gender

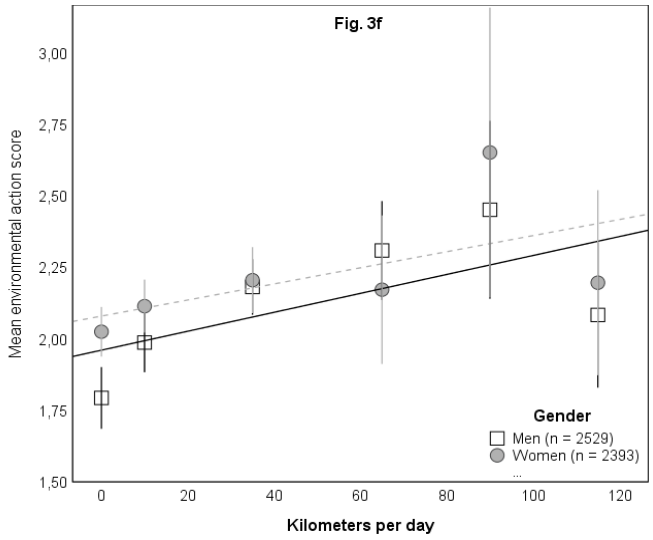












Source: Authors. Note: Importance scores (1 = very unimportant / not at all important, 5 = very important / extremely important). Kilometers per day relabeled to the assumed mean of each category (e.g., not regularly = 0.01 km, under 20 km/day = 10 km/day, 20-50 km = 35 km/day, etc.). Error bars indicate 95% confidence interval.

Interestingly, this is not the case when studying the general question about environmental importance. When comparing the self-reported mean daily kilometers per rank of general environmental importance (Figure 3c), men and women have more jumbled associations in the stated importance of the environment and the number of kilometers driven. Equally messy are the stated mean environmental importance rankings given per daily kilometers (Figure 3d).

Lastly, when looking at how our sample's stated daily kilometers relate to actual environmental actions, Figure 3e shows a clear upward trend in mean kilometers per day with more environmental actions taken. This most likely is mediated by household income, as household income and the number of environmental actions show a slight positive correlation ($r_s = .135$ with $p < .01$). And as a higher income correlates positively with more km a day ($r_s = .250$ with $p < .01$), there is an upward relationship for both men and women with higher incomes and the number of environmental activities they have completed or are engaged in (Figure 3f).

Although fairly infrequent, explanations for some of these factors did emerge from our focus groups. A male participant in FG6 mentioned that women have stronger environmental values which accounts for switching to smaller or cleaner cars, which may even be "girly":

> *Men find it more difficult to switch to cleaner or small cars, and women can switch easier. Women have a stronger environmental ethic, perhaps reflecting motherly feelings, which is why women in general don't like to drive that much, compared to men. Most men like to drive, but I don't know many women who love to drive. My girlfriend for example likes a small car that she can park easily and is easy to go around the city, whereas a big gas-guzzling vehicle, she*

> *won't touch it. Who likes big cars that make a lot of noise, go really fast and are super nice and comfy? Men. Who is environmentally-friendly and likes small cars? Then you're girly and more feminine.*

Later on, in the all-male FG6, the discussion touched upon empathy and the gendered identity of cars:

> *If you look at the electric vehicle market now, you can say it's gender neutral, but it may be a bit more leaning to women because they play to that 'good conscience' feeling because you are doing good for the environment. Manufacturers of EVs can even target that empathy. If you look at the cars in the electric vehicle market, you have a Nissan Leaf, which is mostly white, I would never buy a white car. I mean some guys would but I think that's more like the feminine kind of appeal that it has, and the BMW i3, another one, it also just looks hideous, it has round figures, it has squares, it is supposed to be trendy and futuristic but it's ugly. If you look at traditional masculine cars, like a Chevrolet Charger it's gender-neutral. But EVs are effeminate and environmental.*

In the all-female FG7, a participant also elaborated on how automobility is a gendered and sexualized on the market:

> *The car, as a status symbol, is gendered. You see the car commercials and they sell it like "this is a woman's car" and it'll be red, safe, and kind of small and it drives around the city. It will be children friendly and stuff like that, and usually with room for a dog. I think it would be women of course going into the dealership and women will be buying this, and men wouldn't because they think "oh not for me." Men want something driving fast and something with flames*

> *[laughter] or naked women [more laughter], and driving through a mountain area, it's gendered that way. Also, the car expert on the television is always a man.*

Thus we see meaningful qualitative support that gender shapes and mediates mobility and sustainable automobility preferences.

4.3 H3: Women attach less importance to speed, power, or sound, whereas men will emphasize range, sex appeal, and acceleration.

Our data generally supports this hypothesis as well, with some exceptions. As Table 3 already indicated, our survey data shows some different aspects between men and women when it comes to car characteristics. In this respect, gender (F=1) shows small negative correlations for stated preferences for speed and acceleration as well as technical reliability, while gender (M=1) shows positive correlations for stated preferences for speed and acceleration, design and style, technical reliability and EV range. This may indicate that men do rate technical and aesthetic aspects of cars higher than women (with the exception of size and comfort).

Interestingly, male EV owners show different preferences for car attributes than men in general (gender M = 1). Male EV owners state stronger preferences for acceleration and general environmental concern (positive instead of negative), and a lower, even negative preferences for most of the EV attributes like range, battery life, and public charging. To us this points to the different expectation patterns that come with the experience of driving an EV. Compared to female EV owners, H3 is supported as male EV owners have stronger preferences for speed and acceleration. However, men also expressed a stronger preference for a car's environmental impact. Noteworthy too, is that male and female EV owners show

almost similar negative preferences for range, public charging and charging time, indicating that these are shared levels of concern across genders.

In relation to EV interest, Table 3 shows a different set of stated preferences compared to EV owners. Those men and women who are indicating higher EV interest, show a relatively strong positive preference for ease of operation, technical reliability, safety, fuel savings, environmental impact, and V2G capacity of an EV. This contrasts with those same characteristics including public charging and purchase price which are less, negatively or not related to EV ownership, thus affirming our assumption above that EV owners see these characteristics as less important than those interested participants who do not own an EV. We cannot explain however, why female EV interested participants show stronger preferences than male EV interested participants for EV specific attributes like range, battery life, public charging and charging time. In short, the comparisons indicate that women attach less importance to speed and acceleration, range, design and style as well as technical reliability, but rank safety, financial and environmental aspects clearly higher.

Although not directly mentioned in the survey, issues of sex appeal, sexism, and sexuality did come up repeatedly in our interviews (although only with a small number of male respondents). R89, a male expert on finance in Denmark, suggested that "dick factor" was a strong reason for men adopting EVs:

> *If electric vehicles have a very big advantage, it would be the "dick factor." If you want to go with a blonde you want a car with acceleration. And electric cars they have very good acceleration, therefore they are competitive in the market where you*

> *demand acceleration. You cannot drive fast to Copenhagen but you have the opportunity for 200 meters.*[2]

R196, a male energy expert in Norway, clarified this further, distinguishing between normal, more masculine appearing cars and abnormal, more feminine appearing cars such as the Buddy (see Figure 4), which is a Norwegian city electric car sold by Buddy Electric:

> *The technological leap with Tesla is huge, when you go Tesla, it's like how they used to say 'when you go black you never go back.' When you go Tesla, it's the same thing, it's a totally different car. Let's be honest, though. Other than Tesla, which has some power and acceleration, most EVs are downright ugly. Most of the models I see here look like a [expletive] dustbin. It looks like a plastic can on wheels! Where is the dick factor on that one, you know? I mean, if you put your ass in a Buddy, you immediately look eighty years old. I'd be relegated to a sexless life for sure if I bought one, forget about it! Right, because it's all about feelings when it comes down to buying and owning a car. A man who buys a car, buys it with his dick, he doesn't buy with his brain. That's why Tesla succeeds [with men], it appeals to his dick. Boom. It's got seven hundred horsepower! It accelerates much faster, is a much better drive, more silent, more advanced. It is a technically superior car. Where can you get a conventional car or family car with seven hundred horsepower, you know? You got to get a boner for that, you know?* [3]

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[2] In the interest of accuracy, we are presenting offensive quotations such as this "as is" to avoid sanitizing our results.

[3] Similarly, we are presenting offensive quotations such as "when you go black you never go back" and "boner" "as is" to avoid censorship, the exception being the use of the "f" word.

We fully admit these misogynist statements are in no way representative of all of those experts we interviewed, although they also unmask the thought processes and emotions behind some potential male adopters.

Figure 4: A 2010 model of Buddy Electric's "Buddy," Düsseldorf, Germany

Complicating matters, our data implies it was not only men connecting EVs and conventional cars with sex (or sex appeal), but also some women. In FG2, a male respondent noted:

> *[When] we think about a car we don't think about a means of transport to get from A to B, but we think about the feelings we have. And there needs to be a sound and ... I hated it when my ex-girlfriend used to look at a loud car cruising*

> *the streets … [And I asked] why do you do that? It's just a stupid guy with a very loud engine. But it's this feeling, and she was drawn to it.*

These sentiments clearly connect masculine (sexual) identity with horsepower, acceleration, and some cases a particular brand of EV, Tesla, known for its affiliation with luxury, social signaling, and conspicuousness (Noel et al. 2019b) as well as horsepower and acceleration; or in other cases, conventional cars that are loud and noisy. They may explain why Tesla's Model X comes eighth in the top-ten list of EV sales by make and model for all of Europe, and the Tesla Model S fifth (Kanger et al. 2019). Such sentiments also reveal how discussions about electric mobility become sexualized, with sexual metaphors populating statements and EV purchase decisions influenced by sex.

Interviewees also however discussed some of the issues of safety, comfort, and convenience when considering the merits of EVs. R21, a male expert in electricity systems in Iceland, said that:

> *When I went to buy a car, I immediately gravitated to the Tesla and Volkswagen Passat. I have the kids, I have family. And who controls the expenditure in the family? It's the wife. When she goes out to choose, what is she going to think about? She is not going to value a fine, fast and sleek car. She will ask: Are my kids comfortable? Are they safe? So I think a family would choose a gas car, a regular car that they are used to.*

R49, a male energy and transport researcher in Sweden, connected such attributes to changing demographics relating to parenting and work:

> *In a traditional bourgeois household, let's say the man is driving the big car, the woman maybe works half time and has the small car. Now it's shifting around. The man has the small car to get to work every day, the battery car, the woman is driving*

> *the kids to practice and to school and football and so on and needs a bigger car for that.*

R181, a female energy expert in Finland, challenged the inherent "sexism" with the belief that women are "dumb" and not sophisticated enough to use EVs. As she noted:

> *With EVs, you often have to add these smart systems. But they are sexist and they are ageist. The smart consumer, the archetypical image, is a youngish hip looking, techno savvy white boy in the suburbs … the smart customer is never a woman with two children at home. Although if you think about it, the one at home who's actually dealing with the daily energy system is probably the woman. My husband bought the dishwasher and the washing machine, but I'm actually the one using it.*

Given that the focus groups were more public, issues of sexuality did not arise as frequently as in the interviews, but the discussions did still touch upon the themes of style, safety, comfort, and other aesthetic issues (like sound or smell or color). In the all-male FG6, for instance, respondents said:

> *There are differences to how men and women drive. Men place more emphasis on everything in a car than women. They get utility and pleasure and preferences from different things, like how it looks, and getting from there to there and not having any technical difficulties. My mom, she doesn't care about which car she gets, it has to be red and it needs to be small so she can park it anywhere, and that's pretty much it.*

And, later in FG6, the men present said:

> *There are differences between genders and we have to acknowledge them, men and women work differently because we are different entities, we complement each other, but we are more technical, we are masculine as men right?*

> *Masculinity calls for technicalities, power, and individuality. Somehow electricity doesn't do that, fossil fuel does that. So if you're a very manly man, let's say you would always prefer an inefficient fossil-fuel-consuming Jaguar over the Prius. There's a masculine status associated with conventional cars.*

In contrast, in the all-female FG 7 participants remarked:

> *I like EVs because they don't smell like gasoline (laughter). Yeah, it's true. When I was pregnant, this thing [the smell of petrol] made me sick. I didn't use to sit in the car because of it.*

And, later in FG7 a female participant rejected that women mainly prefer small cars:

> *I have a boyfriend at the moment and I want to have a car and he goes like "we go for [the Volkswagen] Up!" No, no! I mean, I would like to have a car that I feel safe in, it doesn't have to be [that small]. "No, but it's small, it's good and it's cheap". "Sweetie, listen to me", I want to say, "I need to feel safe in the car."*

These statements all emphasize some of the important non-functional, non-monetary, and symbolic elements of cars as well as particular preferences for design.

Although more difficult to classify, a recurring and crosscutting theme throughout the focus groups revolved around the aesthetic issues of style and sound. A female participant in FG3 mentioned power, noise, and the "feel" of the car as important attributes:

> *EVs do not really appeal to men, because men want that feeling, that power as they sit in there and turn it on and are like "What I can't hear it! Is it on?" Yeah I know. You can't really tell you are going fast in an EV. It's just boring.*

> *It's bland. You want to go fast and listen to the engine. That is the main problem with men.*

This same theme arose in the all-female FG7:

> *If you are really a car-lover, you need that roar. The guy friends that I had who love cars, they really like turning on the car and vroom and all that [laughter]. I think that's part of loving it for them, so I guess they would maybe not get the same kind of sound with an EV?*

And, in FG8 a participant remarked:

> *I remember once a friend of mine said "the sad part about electrical car is that it doesn't make any noise, and the noise is the sexiest part of the car. You started the engine [revving sound], what are you going to do if you don't have the sound?" And I was like, "that's the whole point!" It is so nice that they don't make any noise. But this customer group that likes noise is going to be extremely hard for electric cars to appeal to.*

These reflections also underscore further non-monetary aspects of EVs and mobility and also point towards the potential importance of gendered perceptions of design features.

Strikingly, the association between masculinity and conventional mobility does not always hold. As two male participants in FG6 stated:

> *I think it is wrong that it [EVs and V2G] is not appealing for men. For some it might not be, if they want the traditional power of a car. But for many men I think it would be appealing to send an environmental signal that you are responsible. It's like, get out of that stereotype that men have to have a powerful car.*

Such qualitative statements suggest that cars and EVs are stereotyped and gendered such that

some women generally prefer quieter or more peaceful vehicles whereas some men prefer louder and more obvious vehicles, but also perhaps vice versa.

5. Conclusion

In conclusion, the gendered nature of Nordic transport, electric mobility, and V2G—reflected in stated preferences for conventional forms of mobility as well as EVs and particular attributes of vehicles—is dynamic and significant. We can state with a degree of certainty, triangulated across our three methods (survey, interviews, and focus groups) that:

- Men reported greater usage rates for cars and EVs, greater chances of ownership, and greater distances travelled every day via a private car. Quantitatively, most of these show a statistically significant, yet modest impact on differences between the mean for men versus women. The exception with a very strong effect is stated EV ownership, for which twice as many men as women own an EV;
- Women reported higher levels of environmental awareness, as well as stronger preferences for safety and convenience, especially when they drive or own family cars;
- Women reported attaching less importance to design attributes such as speed, power, or sound, whereas men reported prioritizing speed, acceleration, status, and (at times) sex appeal;
- Enabling V2G or vehicle-grid-integration does little to alter these stated preferences, i.e., it does not have a meaningful association with any of our three hypotheses, although it did have slightly greater appeal to women.

In sum: We see a prominent association between stated car ownership and gender, kilometers driven and gender, and experience with and ownership of EVs and gender, all orientated towards men. Moreover, women tended to value safety, purchase price, and environmental impact; men, power, speed, sound, and in at least two instances the “dick factor” of

impressing women, particularly when comparing a Norwegian Buddy with an American Tesla.

Despite these findings, our study does point the way towards fruitful future research. Methodologically, full regression models and multivariate data analysis focusing on gender as well as gender in context (offset against public transport options, employment, income etc.) would complement the analysis here, as would specified gender-oriented surveys among non-EV buyers, EV buyers and EV owners. A mixed-methods exploration of other demographic, geographic, or political aspects such as culture, politics, and spatial diffusion would also add depth to our results, explicating how gender gaps, values, preferences, and norms intersect with other attributes of identity (which then influence driving patterns, preferences, etc.). Conceptually, our paper is almost entirely empirical, although it can certainly help inform those designing or refining theories and analytical frameworks about both gender and mobility. Topically, more attention to gendering vs use value would generate practical information for marketing efforts on behalf of designers, manufacturers, and retailers. Furthermore, we focus our research here on the "demand side," on users, but a focus on the "supply side," on industry and manufacturers, could also be fruitful to explore.

Relatedly, because our survey instrument treated gender as consisting of three variables (male, female, other), it is less able to fully explore the hypothesis about gender norms and roles. We are able to infer results, but that inference underscores a fairly weak connection of our survey components to the gender norms and roles stream of research (we admittedly designed the survey before reading this important stream of research). Our data seems to imply or at least suggest that EVs provide more opportunity to *mixing up* some of the gender distinctions previously applied to cars, especially given that more than twice as many EVs are owned by men in our sample than conventional cars, whereas conventional car ownership is closer together (a few percentage points apart by gender). Anfinsen et al.

(2019) reach a similar finding, noting in Norway that EVs have become "hybrid constructions" that appeal equally to men and women. Our qualitative statements from the interviews and focus groups further drive home this point, indicating that sometimes it is women who prefer louder, conventional cars and some men who want quieter, more sustainable forms of mobility. The idea that EVs are therefore always more feminine, and conventional cars always more masculine, is not always correct, although gender has many expressions and needs further deconstruction.

Nonetheless, our results reveal how EVs are breaking some conventional popular attributes of a car while reinforcing others; there was quite some discussion in the focus groups about the changing aesthetics of sound, the masculinity of environmentally friendly cars and the interplay between status, size and practicality (small EVs as most favored by commuters). And while sex appeal did recur within some of the interviews, the discussions in the focus groups were more reflexive as they questioned such stereotypes and brought attention to the origin of such images and the gendering of cars through advertisements and marketing. Thus, our study challenges more simplistic assumptions made within in the literature on the gender travel gap, such as "men are more likely to adopt EVs" (Priessner et al. 2018).

Furthermore, that our results currently point to stated male EV ownership patterns does not mean that these results will persist into the future. In fact, in earlier work (Sovacool et al. 2018a) we suggested that larger shares of women and recent retirees would potentially benefit from and appreciate the driving characteristics of EVs while being less inhibited in daily practice by its technical range limitations. As such, EV advertisements have two potential markets beyond the currently male buyers. This can be done not necessarily by stereotypically gendering cars, but actually highlighting more gender neutral aspects of use value and actively engaging with these potential target groups.

Ultimately, our analysis suggests that the Nordic transport system is undergoing major transformations, and these changes affect, and are affected by, available gender patterns, identities, and inequalities. These changes could continue to erode so-called "traditional" vehicle preferences and vehicle use patterns, and they will undoubtedly influence the private and shared automobility markets of the future—and the gender gaps, values, preferences and roles associated with them.

6. References

Aldred, Rachel, Bridget Elliott, James Woodcock & Anna Goodman (2017) Cycling provision separated from motor traffic: a systematic review exploring whether stated preferences vary by gender and age, Transport Reviews, 37:1, 29-55

Anfinsen, Martin, Vivian Anette Lagesen, Marianne Ryghaug, Green and gendered? Cultural perspectives on the road towards electric vehicles in Norway, Transportation Research Part D: Transport and Environment, In press, corrected proof, Available online 28 December 2018

Basaric, Valentina et al., Gender and age differences in the travel behavior – a Novi Sad case study, Transportation Research Procedia 14 (2016) 4324 – 4333

Clayton, William et al., Where to park? A behavioural comparison of bus Park and Ride and city centre car park usage in Bath, UK, Journal of Transport Geography 36 (2014) 124–133

Croeni, Jan. Sustainable Mobility for Singapore, In Amy Lugg and Mark Hong (Eds.) Energy Issues in the Asia-Pacific Region (Singapore: Institute for Southeast Asian Studies, 2010), pp. 293-311.

Daramy-Williams, Edmond, Jillian Anable, Susan Grant-Muller. A systematic review of the evidence on plug-in electric vehicle user experience, Transportation Research Part D: Transport and Environment, In press, corrected proof, Available online 13 February 2019

Denton, Fatma. 2002. "Climate Change Vulnerability, Impacts, and Adaptation: Why Does Gender Matter?" Gender and Development 10(2), pp. 10-20.

Edwards, S.J. et al., Optimising landmark-based route guidance for older drivers, Transportation Research Part F 43 (2016) 225–237

European Commission, Attitudes on issues related to EU Transport Policy - Flash Eurobarometer, Analytical report, Brussels, 2007

Fan, Yingling, Household structure and gender differences in travel time: spouse/partner presence, parenthood, and breadwinner status, Transportation (2017) 44:271–291

Franz, Kathleen. "Women's Ingenuity," In Tinkering: Consumers Reinvent the Early Automobile (Philadelphia: University of Pennsylvania Press, 2005), pp. 43-73.

Friis, Freja; Christensen, Toke Haunstrup; Gram-Hanssen, Kirsten. Smart grid solutions in the everyday life of households : Electric vehicles and time-of-use pricing. Aalborg University, 2016.

Husu, Liisa (2000) Gender Discrimination in the Promised Land of Gender Equality, Higher Education in Europe, 25:2, 221-228

IBM. 2017. IBM SPSS Statistics Algorithms. New York: IBM, available at ftp://public.dhe.ibm.com/software/analytics/spss/documentation/statistics/25.0/en/client/Manuals/IBM_SPSS_Statistics_Algorithms.pdf.

Jay, Timothy and Kristin Janschewitz. 2008. The pragmatics of swearing, Journal of Politeness Research. Language, Behaviour, Culture, Volume 4, Issue 2, Pages 267–288.

Jay, Timothy. (2009). Do offensive words harm people? Psychology, Public Policy, and Law, 15(2), 81-101.

Kanger, L, F Geels, BK Sovacool and JW Schot. "Technological diffusion as a process of societal embedding: Lessons from historical automobile transitions for future of electric mobility," Transportation Research Part D (in press, 2019)

Kawgan-Kagan, Ines. "Early adopters of carsharing with and without BEVs with respect to gender preferences" Eur. Transp. Res. Rev., pp. 7-33, (2015).

Kawgan-Kagan, Ines and Mareike Popp, Sustainability and Gender: a mixed-method analysis of urban women's mode choice with particular consideration of e-carsharing, Transportation Research Procedia (in press 2018)

Kellstedt, Paul M., Sammy Zahran, and Arnold Vedlitz. 2008. "Personal Efficacy, the Information Environment, and Attitudes Towards Global Warming and Climate Change in the United States." Risk Analysis 28(1), pp. 113-126.

Kempton W, Letendre S. 1997. Electric Vehicles as a new source of power for electric utilities, Transportation Research 2(3), pp. 157-175.

Kempton, Willett and Jasna Tomic, Vehicle-to-grid power fundamentals: Calculating capacity and net revenue, Journal of Power Sources 144 (2005) 268–279

Kempton, Willett and Jasna Tomic, Vehicle-to-grid power implementation: From stabilizing the grid to supporting large-scale renewable energy, Journal of Power Sources 144 (2005) 280–294

Kendall, M. G. 1955. Rank correlation methods. London: Charles Griffin.

Kester, J, L Noel, G Zarazua de Rubens, and BK Sovacool, "Promoting Vehicle to Grid (V2G) in the Nordic Region: Expert advice on policy mechanisms for accelerated diffusion," Energy Policy 116 (May, 2018), pp. 422-432.

Kester, J, L Noel, G Zarazua de Rubens, and BK Sovacool. "Policy Mechanisms to Accelerate Electric Vehicle Adoption: A Qualitative Review from the Nordic Region," Renewable & Sustainable Energy Reviews 94 (October, 2018), pp. 719-731.

Kirkpatrick, Lee A., 2013. A Simple Guide to IBM SPSS Statistics for Versions 20.0 & 21.0. Belmont, CA :Wadsworth.

Kronsell, Annica, Lena Smidfelt Rosqvist & Lena Winslott Hiselius (2016) Achieving climate objectives in transport policy by including women and challenging gender norms: The Swedish case, International Journal of Sustainable Transportation, 10:8, 703-711

Lecompte, Maria Caroline and Juan Bocarejo S., Transport Systems and their impact on gender equity, Transportation Research Procedia 25 (2017) 4245–4257

Letendre, Steven E. and Willett Kempton. 2002. "The V2G Concept: A New Model for Power?" Public Utilities Fortnightly (February 15, 2002), pp. 16-26.

Likert, Rensis (1932). "A Technique for the Measurement of Attitudes". Archives of Psychology 140: 1–55.

Lutzenhiser, Loren. 1993. "Social and Behavioral Aspects of Energy Use." Annual Review of Energy and Environment 18: 247-289.

Mahadevia, Darshini and Deepali Advani, Gender differentials in travel pattern – The case of a mid-sized city, Rajkot, India, Transportation Research Part D 44 (2016) 292–302

McCarthy, Orla Thérèse et al., How transport users perceive personal safety apps, Transportation Research Part F 43 (2016) 166–182

McCright, Aaron M et al., Ideology, capitalism, and climate: Explaining public views about climate change in the United States, Energy Research & Social Science 21 (2016) 180–189

Miranne, Kristine B. and Alma H. Young (Eds.). 2000. Gendering the City: Women, Boundaries, and Visions of Urban Life (New York: Roman and Littlefield).

Nasar, J. L., Fisher, B., & Grannis, M. (1993). Proximate physical cues to fear of crime. Landscape and Urban Planning, 26, 161–178.

National Academies of Science. Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering. Washington, DC: 2007.

Noel, L, G Zarazua de Rubens, J Kester, and BK Sovacool. "Beyond Emissions and Economics: Rethinking the co-benefits of Electric Vehicles (EVs) and Vehicle-To-Grid (V2G)," Transport Policy 71 (November, 2018), pp. 130-137.

Noel, LD, AP Carrone, AF Jensen, GDR Zarazua, J Kester, and BK Sovacool. "Willingness to Pay for Electric Vehicles and Vehicle-to-Grid Applications: A Nordic Choice Experiment," Manuscript under review

Noel, L, J Kester, G Zarazua de Rubens, and BK Sovacool. 2019a. *Vehicle-to-Grid: A Sociotechnical Transition Beyond Electric Mobility* (Basingstoke: Palgrave, in press, 2019).

Noel, L, BK Sovacool, J Kester, and G Zarazua de Rubens. 2019b. "Conspicuous Diffusion: Theorizing How Status Drives Innovation in Electric Mobility," Manuscript under review.

Nordic Council of Ministers. 2017. Nordic Statistics 2017. Available at https://norden.diva-portal.org/smash/get/diva2:1146911/FULLTEXT05.pdf.

O'Connor, Richard Bord, and Ann Fisher. 1999. "Risk Perceptions, General Environmental Beliefs, and Willingness to Address Climate Change." Risk Analysis 19(3), pp. 461-471.

Oldenziel, Ruth. "Boys and Their Toys: The Fisher Body Craftsman's Guild, 1930- 1968, and the Making of a Male Technical Domain," Technology and Culture 38 (1997): 60- 96.

Polk, M., 2004. The influence of gender on daily car use and on willingness to reduce car use in Sweden. Journal of Transport Geography 12 (3), 185–195

Priessner, Alfons et al. Predictors of electric vehicle adoption: An analysis of potential electric vehicle drivers in Austria. Energy Policy, Volume 122, November 2018, Pages 701-714

Reisigl, Martin and Ruth Wodak. Discourse and Discrimination: Rhetorics of Racism and Antisemitism. London: Routledge, 2000.

Rezvani, Z., J. Jansson, et al. (2015). "Advances in consumer electric vehicle adoption research: A review and research agenda." Transportation Research Part D: Transport and Environment 34(Supplement C): 122-136

Sánchez, M Isabel Olmo and Elvira Maeso González, Gender differences in commuting behavior: Women's greater Sensitivity, Transportation Research Procedia 18 (2016) 66 – 72

Scharff, Virginia. "Femininity and the Electric Car," in Automobile in American Life and Society (2004), available at http://www.autolife.umd.umich.edu/Gender/Scharff/G_casestudy2.htm.

Scheiner, Joachim and Christian Holz-Rau, Gendered travel mode choice: a focus on car deficient households, Journal of Transport Geography 24 (2012) 250–261

Scheiner, Joachim and Christian Holz-Rau, Gender structures in car availability in car deficient households, Research in Transportation Economics 34 (2012) 16-26

Siegel, S. 1956. Nonparametric statistics for the behavioral sciences. New York: McGraw-Hill

Siren, Anu and Sonja Haustein, Baby boomers' mobility patterns and preferences: What are the implications for future transport? Transport Policy 29 (2013) 136–144

Smith, Nina, Valdemar Smith, Mette Verne, (2011) "The gender pay gap in top corporate jobs in Denmark: Glass ceilings, sticky floors or both?", International Journal of Manpower, Vol. 32 Issue: 2, pp.156-177

Solá, Ana Gil. Constructing work travel inequalities: The role of household gender contracts, Journal of Transport Geography 53 (2016) 32–40

Sovacool, BK, J Axsen, and W Kempton. "The Future Promise of Vehicle-to-Grid (V2G) Integration: A Sociotechnical Review and Research Agenda," Annual Review of Environment and Resources 42 (October, 2017), pp. 377-406.

Sovacool, BK, J Kester, L Noel, and G Zarazua de Rubens. 2018a. "The demographics of decarbonizing transport: The influence of gender, education, occupation, age, and household

size on electric mobility preferences in the Nordic region," Global Environmental Change 52 (September, 2018), pp. 86-100.

Sovacool, BK, J Kester, G Zarazua de Rubens, and L Noel. 2018b. "Expert perceptions of low-carbon transitions: Investigating the challenges of electricity decarbonisation in the Nordic region," Energy 148 (April, 2018), pp. 1162-1172.

Sovacool, BK, L Noel, G Zarazua de Rubens, J Kester. 2018c. "Reviewing Nordic Transport Challenges and Climate Policy Priorities: Expert Perceptions of Decarbonisation in Denmark, Finland, Iceland, Norway, Sweden," Energy (in press, 2018)

Terjesen, S. & Singh, V. Female Presence on Corporate Boards: A Multi-Country Study of Environmental Context. J Bus Ethics (2008) 83: 55-63.

Tomic, Jasna and Willet Kempton. 2007. "Using Fleets of Electric-Drive Vehicles for Grid Support." Journal of Power Sources 168, pp. 459-468.

Tonkiss, Fran. 2005. Space, the City and Social Theory: Social Relations and Urban Forms (Cambridge: Polity Press).

Upham, Paul et al. Socio-technical transition governance and public opinion: The case of passenger transport in Finland, Journal of Transport Geography 46 (2015) 210–219

Vassileva, Iana and Javier Campillo, Adoption barriers for electric vehicles: Experiences from early adopters in Sweden, Energy 120 (2017) 632-641

Viscusi, W. Kip and Richard J. Zeckhasuer. 2006. "The Perception and Valuation of the Risks of Climate Change: A Rational and Behavioral Blend." Climatic Change 77(1-2), pp. 151-177.

Zheng, Zuduo et al., Preference heterogeneity in mode choice based on a nationwide survey with a focus on urban rail, Transportation Research Part A 91 (2016) 178–194

7. Appendix I – Survey instrument

See separate attachment submitted online